

Short Note

Coastal Bryde's Whales' (*Balaenoptera edeni*) Foraging Area Near Weizhou Island in the Beibu Gulf

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As top predators, the spatial distribution of cetacean species can provide key indicators for the conservation of marine ecosystems (Bossart, 2011). Information on large whale occurrence in China was collected during whaling operations in the 1950s to 1970s (Wang, 2011). After the Chinese government terminated whaling in 1980, information about the occurrence, anatomy, and distribution of large cetaceans has been collected mostly from rare stranding events. As such, the distribution of whales in China is currently not well known.

Bryde's whales (*Balaenoptera edeni*) are among the least known of the baleen whales (Kato & Perrin, 2018), and they can be seen between latitudes 40° N and 40° S, in coastal and offshore waters (Tezanos-Pinto et al., 2017). This species

is listed as “Least Concern” in the International Union for Conservation of Nature's *Red List of Threatened Species* (Cooke & Brownell, 2018). Kershaw et al. (2013) identified two subspecies within the Indian and Pacific regions, *B. edeni brydei* and *B. edeni edeni*—the large and small forms, respectively, of this species.

Bryde's whale strandings have occurred along the Chinese coast (Figure 1), including in the Yellow Sea, East China Sea, and South China Sea (Parsons et al., 1995; Kato et al., 1996; Zhou, 2004; Jefferson & Hung, 2007; Wang, 2011). To date, the only putative population of Bryde's whales in the region was reported near Hong Kong (Jefferson & Hung, 2007).

Between 2015 and 2018, sightings of unidentified baleen whales were reported by fishermen

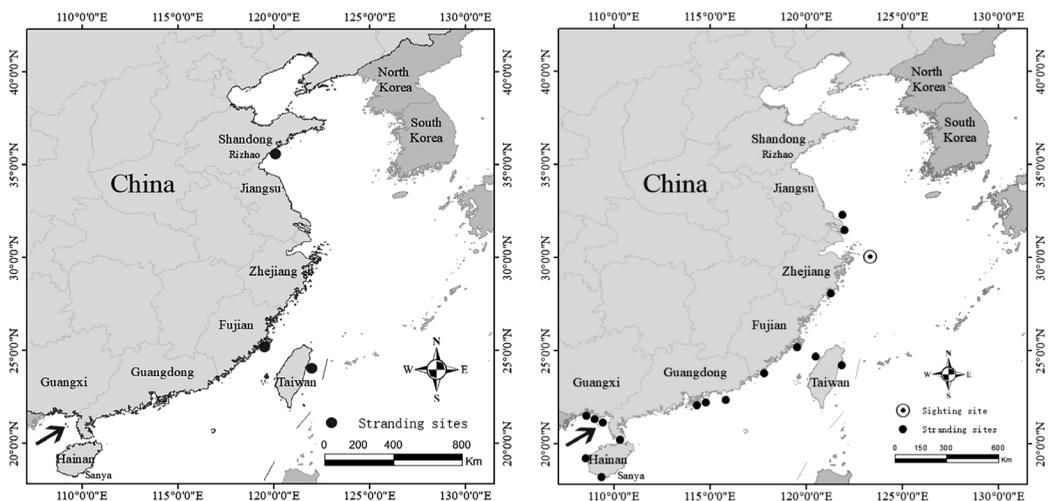


Figure 1. Previous records and distribution of Bryde's whale (*Balaenoptera edeni*) (left: large form; right: small form) in China (cited from Zhou [2004] and Wang [2011]); the arrow indicates the survey area.

around Weizhou Island, Beibu Gulf, China. They suggested the presence of a feeding ground for baleen whales in that area.

From 3 April to 11 May 2018, we conducted vessel-based photo-identification surveys in the area between Weizhou Island and Xieyang Island where fishermen reported sighting whales. A motor vessel (8.27 m long; 180 hp engine) was used to conduct the field surveys when weather permitted (Beaufort Sea State ≤ 3 ; swells ≤ 1 m); the search speed was roughly 12 to 18 km/h. Survey personnel included four to seven observers (cetacean scientists and sometimes trained volunteers) and a vessel operator. Two observers continuously searched a 100° arc across the bow out to 90° on their side of the boat with naked eye. Every 5 min, they also scanned the 360° along the ocean surface using binoculars (Steiner Safari 8 \times 30). Other members of the survey crew observed opportunistically. Once whales were sighted, the vessel slowed to 2 to 9 km/h and took a parallel course to the whales. Photos (acquired using Canon 1DX Mark II with 100-400mm zoom lens and 1.4x converter) and videos (using Sony PXW-FS5) were captured simultaneously. Cetacean scientists with more than ten years of experience took the photographs. An unmanned aerial vehicle (Dajiang Phantom 3 Professional) was used during seven sightings by a professional pilot at a target altitude of 6 to 30 m. The sighting time, longitude and latitude (GPS), water depth, water temperature, estimated group size, and surfacing interval of each sighting were recorded.

Between 8 April and 23 May, when weather did not permit vessel-based surveys, two cetacean scientists and four trained volunteers (different individuals than the volunteers in the vessel-based fieldwork) conducted interviews with fishermen in nine villages on Weizhou Island and one village on Xieyang Island. All fishermen were interviewed individually; each interview lasted about 20 to 30 min. First, the demographic information of the interviewee, such as age, fishing area, etc., was recorded. Then, marine mammal photos were shown to the interviewees to assist them with species identification. The question list was as follows: (1) whether marine mammals were seen during fishing activities, (2) which year did they first sight marine mammals, (3) the frequency of encounters with marine mammals, (4) the times (year/season/month) when marine mammals were sighted, (5) whether calves were seen, (6) whether dead marine mammals were found, and (7) where is the core area of marine mammal distribution.

Individual Bryde's whales can be identified by matching distinctive marks on or near the dorsal fin (Tershy et al., 1990; Wiseman et al., 2011; Figueiredo & Simão, 2014; Thongsukdee et al.,

2014). Photos were taken perpendicular to the whale's body axis when possible. All the photos were classified into three grades (i.e., excellent, good, and poor) based on picture resolution, relative angle to the body axis, and visibility of the dorsal fin. Only excellent or good photos were used for identification. The whales were individually identified by marks such as nicks, notches, scars, cuts, and deformities on or near the dorsal fins (Figueiredo & Simão, 2014). The identified whales were further divided into two datasets: (1) the left-side catalogue and (2) the right-side catalogue. We then compared the whales' dorsal fin shape, scars, etc., in the two catalogues to determine whether they represented the same whale.

A total of 55 questionnaires were collected. The mean age of responding fishermen was $52.0 \pm \text{SD}10.7$ (28 to 76), and they had been fishing for $26.0 \pm \text{SD}12.9$ (3 to 56) years. Eighty percent of these fishermen reported sighting large whales. These fishermen described that whales were present near Weizhou Island throughout the year, especially in March and April (Figure 2). And 54.5% of fishermen (24 of 44) believed that the number of whales was increasing in the past 2 to 3 years.

Vessel-based surveys were carried out on 11 d between 3 April to 11 May covering 766.4 km total search distance. Bryde's whales were sighted nine times along the northeast area of the Xieyang Island. A total of 6,960 photos and 550 min of video were recorded (Table 1; Figure 3). (Supplemental video clips are available on the *Aquatic Mammals* website: https://www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147.) The mean group size was 1.9 ± 0.8 ; the largest group consisted of three whales.

Some photos clearly showed one median ridge and two small lateral ridges on the whales' rostrums

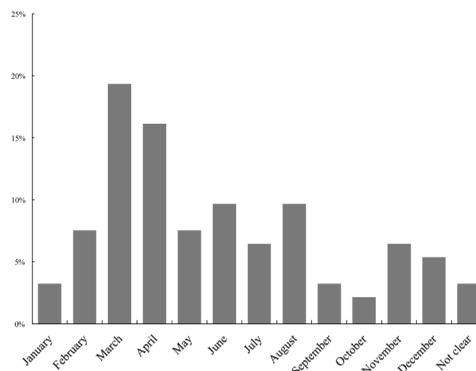


Figure 2. The percent of fishermen in Weizhou and Xieyang Islands who reported sighting large whales in each month

Table 1. Summary of species encountered with search effort, position, number of photos and duration of videos, group size, and identified whales

Date	Search effort (km)	Species	GPS coordinates	No. of photos	Video (min)	Group size	# whales identified
3 April 2018	66.8	Bryde's whale	N20°55.273' E109°14.457'	1,326	64	1	WZ01
9 April 2018	48.3	Bryde's whale	N20°56.385' E109°13.308' N20°56.680' E109°13.775'	2,901	95	3 3	WZ02 WZ03 WZ04 WZ05 WZ06 WZ07
10 April 2018	70.5	Bryde's whale	N20°56.678' E109°14.310'	240	37	1-2	WZ08
11 April 2018	81.1	Bryde's whale	N20°54.784' E109°18.101'	1,355	94	1-2	WZ04
12 April 2018	49.8	Bryde's whale	N20°56.050' E109°13.946'	751	72	2-3	
13 April 2018	57.5	Bryde's whale	N20°56.420' E109°14.377"	147	114	2	WZ09
17 April 2018	50.5	Bryde's whale	N20°56.802' E109°13.912'	181	19	2	
18 April 2018	70.3	Bryde's whale	N20°56.613' E109°14.047'	3	45	1	
21 April 2018	63.0	No sighting		56	10	0	
24 April 2018	68.8	No sighting		0	0	0	
11 May 2018	139.8	No sighting		0	0	0	
Total	766.4			6,960	550		9

(Figure 4A & B), which are the key identification features of Bryde's whales (Leatherwood & Reeves, 1983; Smultea et al., 2011, 2012; Jefferson et al., 2014). Based on photo-identification, nine left-side and seven right-side individuals were identified, respectively. Four individuals were identified from photos of both sides. Most individuals were observed only once, but one Bryde's whale (WZ04) was sighted twice (Table 1).

During vessel surveys, lateral lunge feeding behaviour was observed four times (Figure 4A & B); Chinese herring (*Ilisha elongate*), golden sardine (*Sardinella allecia*), and round scad (*Decapterus maruadsi*) were likely being fed upon. Further, the body lengths of two whales (about 9.33 and 7.82 m, respectively) were estimated with reference to the known survey vessel length (8.27 m) based on the photos by an unmanned aerial vehicle (Dajiang Phantom 3 Professional; lens, FOV 94° 20 mm, f2.8; Figure 4C), suggesting that these two individuals were likely juvenile or subadult Bryde's whales.

After the moratorium on commercial whaling in 1980 when China joined the International

Whaling Commission (Wang, 2011), Chinese cetacean researchers have focused their studies on the Indo-Pacific humpback dolphin (*Sousa chinensis*), Yangtze finless porpoise (*Neophocaena asiaeorientalis*), and baiji (*Lipotes vexillifer*), rather than on large whales. Consequently, historic information on Bryde's whales was collected mainly from stranding records. Because of morphological similarities, these records might also include whales that were misidentified as sei whales (*Balaenoptera borealis*) or Omura's whales (*Balaenoptera omurai*) (Kato & Perrin, 2018). Therefore, there is some doubt about the reliability of the previous distribution data on Bryde's whale in Chinese waters. In this study, the whales that we observed near Weizhou Island were visually confirmed to be Bryde's whales.

Sun (1999) highlighted that Bryde's whales inhabit the Beibu Gulf, but no dedicated survey was conducted. Since 2015, several videos and photos of Bryde's whales in Beibu Gulf have been uploaded to the Internet (e.g., <https://www.v4.cc/News-2382393.html>). Although these are not peer-

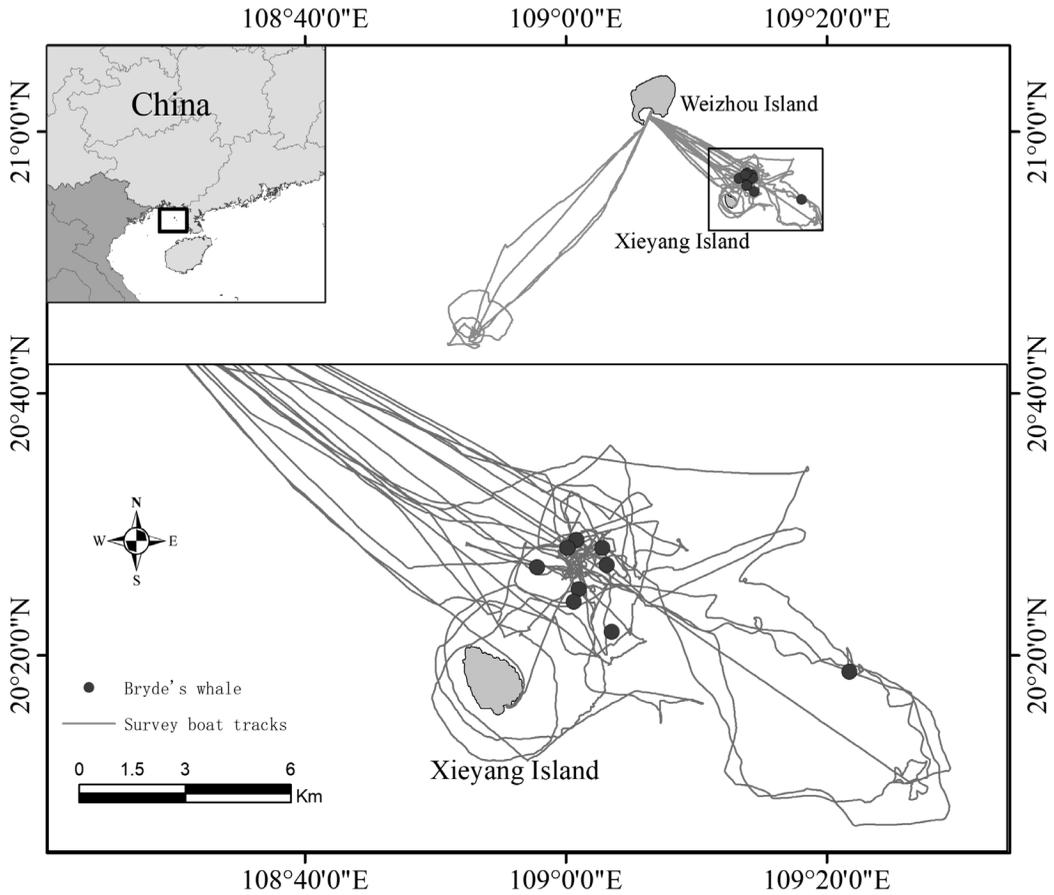


Figure 3. The survey tracks and sighting locations of Bryde's whales near Weizhou Island, China, between 3 April and 11 May 2018

reviewed reports, they do present evidence on a foraging area of Bryde's whales near Weizhou, Beibu Gulf, as has been confirmed in this study.

Although visual sightings could not identify individuals to subspecies, all sightings occurred near the coast—that is, about 2 to 8 km from Xieyang Island, 20 km from Weizhou Island, and 50 km from the mainland—suggesting that they are the coastal, smaller form of this species (*B. e. edeni*). Additionally, the estimated body lengths of the two whales sighted were less than 10 m. Similarly, the Bryde's whales around Hong Kong appear to be the smaller form (Jefferson & Hung, 2007).

Bryde's whales are considered to be the least-migratory baleen whales and usually are distributed in tropical/subtropical waters year-round (John et al., 2012; Werth, 2018). For instance, Bryde's whales (small form) along the coast of southeastern Brazil (Lodi et al., 2015) and Bryde's whales off Kochi (Kato et al., 1996) are residents throughout

the year. A majority of Weizhou fishermen believe that these Bryde's whales are in the area year-round with increased concentrations in spring. This may be related to abundant food resources and fewer anthropogenic activities in Weizhou Island compared to most other coastal waters in China. Bryde's whales feed on small fish species (Iwata et al., 2017). Some small fishes' movement is consistent with the Bryde's whales' seasonal occurrence—for example, round scad moves gradually from south to Weizhou Island in December-January for foraging, spawns in March and April, and then disperses (Chen & Liu, 1982). Moreover, the Beibu Gulf is among the least-exploited and polluted bays in China (Li et al., 2015). The human population in Weizhou Island is low at approximately 14,500, with 50 residents on Xieyang Island. In summary, the abundant fish stocks and limited disturbance near Weizhou Island could support Bryde's whales' nutritional, survival, and reproductive needs.

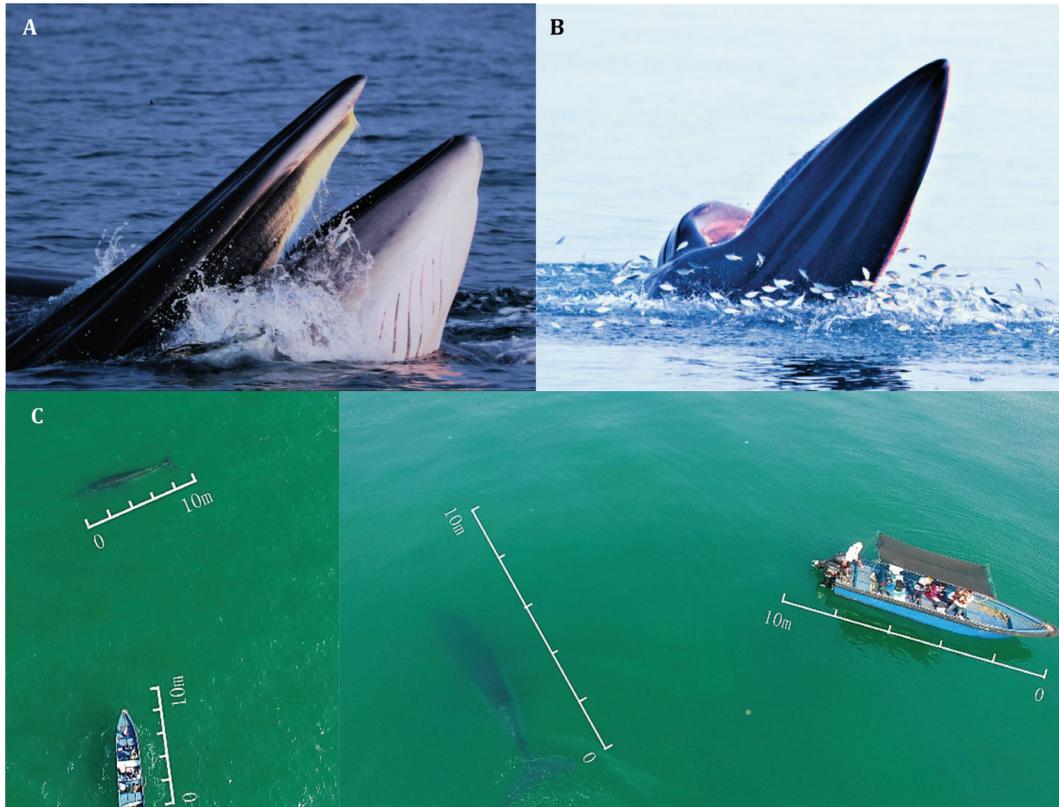


Figure 4. (A) Bryde's whales near Weizhou Island, Beihai, China, between 3 April and 23 May 2018; (B) an example photograph showing one median ridge and two small lateral ridges on the rostrum of a Bryde's whale; and (C) two whales' body lengths were measured at 9.33 m (left) and 7.82 m (right) in reference to the known vessel length of 8.27 m. (Photos by Bingyao Chen and Yu Zhang)

The Weizhou Island Management Committee, China Maritime Surveillance, and China Fishery Administration have begun to design a prohibited area in which speedboats and fishing vessels would not be allowed. Further, a long-term monitoring program on cetaceans should be carried out to help more fully understand the distribution and spatio-temporal dynamics of Bryde's whales and other marine mammals in this area, as well as to make informed decisions on conservation.

Acknowledgments

The present study was financially supported by the National Key Programme of Research and Development, Ministry of Science and Technology (2016YFC0503200); the National Natural Science Foundation of China (31630071); the National Science Foundation of Jiangsu Province of China (BK20171475); Ocean Park Conservation Foundation Hong Kong, OPCFHK (MM04-1819); Major Project of Hydrobios

Resources in Jiangsu Province; and the Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD). Grateful acknowledgements are made to Deguang Lin, Fengfu Li, Weijia Zhang, and Dongying Zhang of the Weizhou Island Management Committee for their support with local affairs; Shuiyou Lin, Yu Zhang, and Feng Yang for their aid with field work; Jinying Yao, Tiejia Deng, Yuyan Peng, and Yandan Lu for their aid in administering the interview survey; and Xiuqing Hao and Ting Li for their drawing assistance.

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